

AGENDA

PROJECT ARGO

6 October 1967

PHASE III PLANS

25X1

1. INTRODUCTION
2. AGRICULTURE
  - A. Land Use, Ecology, Hazards
  - B. Forestry
  - C. Evaluation of Photography for Agricultural Use
3. GEODESY
4. GEOLOGY
5. HYDROLOGY
  - A. Hydrometeorology
  - B. Ground Water
  - C. Surface Water
6. ENGINEERING (Cultural Features)
7. MARINE SCIENCES
8. SUMMARY

**TOP SECRET**

~~PLEASE FORWARD~~

25X1

NPIC.

P R O J E C T A R G O

PHASE III PLANS

OCTOBER, 1967

COPY 9 OF 35

GROUP 1  
Excluded from automatic  
declassification and downgrading

25X1

**TOP SECRET**

## TOP SECRET

### Introduction:

The work done in Phase II has greatly enhanced our knowledge of the imagery materials and will allow better interpretation in Phase III. The work in Phase II, in the Latin American Region, was done on a discipline basis and oriented towards AID as the user Agency. Phase III will also be discipline based but oriented towards all of our agencies as the end users.

In Phase III we will have much more ground truth available, so we should be able to interpret with more confidence than in Phase II. In a very real sense it was unfortunate (from AID's point of view) that the Phase III activity was not scheduled ahead of the Phase II Latin American study. The AID members of the team were the only members of ARGO who felt strongly about this, however, and the team's overall view was that Phase II should be completed as originally scheduled, prior to starting on Phase III. Actually the order of events may not have affected the final outcome much, but we won't really know until Phase III is completed.

The work plans for Phase III can be best presented by each member of the team taking a few minutes to briefly describe how he plans to handle his particular part of the work.

TOP SECRET

25X1

**TOP SECRET****A G R I C U L T U R E****Land Use, Ecology and Hazards****General**

Phase III of the agricultural study will be devoted to an evaluation of TK and other photography in terms of agricultural applications.

**Areas of Interest, Materials and Collateral**

Areas having partial or total coverage of farmland with KH-4 and some cases of KH-7 photography include the following:

Fallon Nevada - partial, KH-4

Weslaco Texas - partial, KH-4

Washington D.C., Rock Creek - Total, KH-4 and KH-7

Phoenix Arizona - Total, KH-4 and KH-7

Imagery will be enlarged and furnished at the following scales:

<u>System</u>	<u>Enlargement</u>	<u>Scale</u>
KH-4 Index	-4 times	1:1,000,000
KH-4	-20 times	1:20,000
KH-7	-6 times	1:20,000

Other imagery that will be used in the evaluations include:

Conventional panchromatic photography at 1:20,000 scale

Color KH-7 if available

Color photography from aircraft

Color infrared photography from aircraft

25X1

**TOP SECRET**

**TOP SECRET**

Collateral material that will be used includes:

Aerial photography described above

Soils maps

Vegetative cover maps

Evaluations of TK Photography

1. For delineation of generalized land use areas:
  - a. Cropland
  - b. Forest
  - c. Water
  - d. Rangeland
  - e. Mountains
  - f. Desert
2. For obtaining more detailed information useful to agriculture:
  - a. Cropland
    - (1) Irrigated
    - (2) Non-irrigated
    - (3) Orchard
    - (4) Vineyards
  - b. Soils
    - (1) General soil types
    - (2) Land capability
    - (3) Slope
  - c. Rangeland
    - (1) Vegetative cover

25X1

**TOP SECRET**

## TOP SECRET

- (2) Vegetative type
- (3) Land capability
- d. Soil moisture
- e. Soil surface condition
- f. Location of irrigation canals and ditches
- g. Location of drain ditches
- 3. For delineation of agricultural limitations
  - a. Erosion
  - b. Drought
  - c. Insects
  - d. Disease
  - e. High water tables
  - f. Salinity
- 4. For use in planning by administrators

### Assumption of Special Considerations in Evaluating TK Photography

- 1. Continuous monitoring of certain ground conditions (ex. soil moisture, crop conditions, etc.)
- 2. Repetitive coverage
- 3. Timeliness of coverage

### Evaluation of Resolution Capability of Photography

- 1. KH-4
- 2. KH-7
- 3. U2
- 4. KH-4 Index
- 5. Color KH-4 if available
- 6. Conventional aerial photography

25X1

TOP SECRET

**TOP SECRET**

Agricultural Damage Assessment by Hurricane Beulah in Lower Rio

Grande Valley of Texas

1. KH-4
2. Simultaneous photographic coverage by aircraft
  - a. Ektachrome
  - b. Ektachrome infrared
3. Ground photography of damaged areas

Recommendations for an Optimum Spacecraft System for Obtaining

Agricultural Photography

25X1

**TOP SECRET**

**TOP SECRET****Forestry - (Evaluation of Imagery for Forestry Purposes)**General Aspects

Forestry applications like any other uses of imagery or sensor output are dependent on what can be recognized and/or measured with a system. To simplify this evaluation, forestry applications will be grouped into two general problem areas which encompass a great number of specific attributes. These problem areas are (1) extensive inventories and (2) operational management data. In the first instance, certain discernible attributes (usually observed on a sampling basis) constitute one or more stages of multiple stage sampling. Spatial control (area to be sampled) is usually based on such items as all the land area in a particular ownership or political entity such as a county or state rather than superimposing attributes obtained from a particular system on controlled base maps. Operational management data on the other hand requires not only recognition of specific attributes such as what species, how much volume, kind and extent of insect or disease attack but the specific geographical location of the occurrence.

For purposes of this evaluation imagery from the KH-4 and KH-7 systems will be studied to determine if specific attributes can be recognized. Standard U. S. Department of Agriculture aerial photographs covering the same areas will also be studied. In addition, the use of color, other sensors and field observations to obtain the same information will be considered. Inasmuch as possible, the relative cost of obtaining and using the various systems as sources of information will be evaluated to determine what specific system(s) will most readily provide the types of information required.

25X1

**TOP SECRET**



**TOP SECRET**Plan of Work

Specific areas on imagery from the various systems covering portions of Washington State and the Washington, D.C. area will be enlarged as follows:

KH-4 Index	4X (1:1,000,000)
KH-4	20X (1:20,000)
KH-7	6X (1:20,000)

U. S. Department of Agriculture aerial photography will be used at contact scale (approx. 1:20,000). Since information from color and other sensors will probably not be available for the sample areas probability of success in attribute recognition will have to be postulated based on information available from research studies. The sample areas were selected because of an abundance of ground truth and being representative of typical eastern and western U. S. forest conditions.

In addition, since one of the requirements of operational management data is specific geographical location, mosaics of portions of one of the sample areas will be constructed using both conventional photography and KH-4 and/or KH-7 imagery. Mosaics of this type along with appropriate overlays could be used to show various resources or resource problems in place.

Prints of the various types of imagery will be examined to determine the probability of successful recognition and/or measurements of various attributes related to specific forestry applications.

The various systems as sources of information will be rated as providing excellent, good, general, very general or no significant information.

25X1

**TOP SECRET**

**TOP SECRET**

Forestry Applications

Extensive Inventory:

- I. Land Use
  - A. Non-forest land
  - B. Forest land
    - 1. Unproductive forest land
    - 2. Commercial forest land
  - C. Overview of land use patterns
- II. Stand volume per acre
  - A. Stand height
  - B. Stand density (percent crown closure)
- III. Stand size class
  - A. Saw timber
  - B. Pole timber
  - C. Seedling and sapling
  - D. Non-stocked
- IV. Species type group
  - A. Softwood (conifer) type
  - B. Hardwood (deciduous) type

Operational Management Data (Commercial Forest Land Only)<sup>(1)</sup>

- I. Stand description data (management prescription data)
  - A. Productivity
    - 1. Slope
    - 2. Aspect
    - 3. Soil type

---

<sup>(1)</sup> Items that apply to more than one type of management data are generally only listed once to simplify list.

**TOP SECRET**

**TOP SECRET**

4. Physiographic site

- a. Xeric
- b. Mesophtic
- c. Hydric

B. Stand Characteristics

1. Species type

2. Stand size class

- a. Saw timber
- b. Pole timber
- c. Seedling and sapling
- d. Non-stocked

3. Stocking

- a. Stand density (percent crown closure)
- b. Basal area per acre

4. Volume per acre

- a. Species volume per acre
- b. Quality

5. Condition

II. Timber harvesting data

A. Product volume per acre

- 1. Species volume per acre
  - a. Diameter distribution
  - b. Quality

B. Access

- 1. Preliminary road location
- 2. Detailed (paper) road location (topographic base)

25X1

**TOP SECRET**

## **TOP SECRET**

- C. Hazard reduction planning
  - 1. Slash disposal fire line location
- D. Regeneration planning
  - 1. Planting and/or seeding site maps
- III. Timber Protection
  - A. Detection of insect attacked trees
    - 1. Tree species identification
    - 2. Insect species identification
    - 3. Proportion of trees affected
    - 4. Area of infestation
  - B. Detection of diseased trees
    - 1. Tree species identification
    - 2. Identification of disease
    - 3. Proportion of trees affected
    - 4. Area of infestation
  - C. Detection of fires
    - 1. Area burned
    - 2. Damage assessment
- IV. Use of forest land for other than timber production
  - A. Recreation site planning
    - 1. Camp ground and picnic site location
      - a. Potential water supply
      - b. Sanitation (sewage disposal)
      - c. Type of vegetative cover
      - d. Access
      - e. Hazards
      - f. Surficial material

25X1

**TOP SECRET**

## TOP SECRET

2. Wilderness trail and shelter location
  3. Water related activity
    - a. Water source
    - b. Size and depth of lakes
    - c. Stream flow
      - (1) Volume
      - (2) Velocity
    - d. Water temperature
  4. Winter sports
    - a. Period of snow coverage
    - b. Depth of snow
    - c. Potential for ski lift development
- B. Wildlife habitat evaluation
1. Game population census
  2. Food supply
    - a. Vegetative species and production
    - b. Utilization
  3. Extent of area suitable for specific types of wildlife
- C. Soil erosion and flood prevention planning

Based on experience to date the probability of successful recognition of those items that relate to specific forestry applications are indicated in Figure 1. This evaluation is preliminary and is for illustrative purposes only since additional work may result in rating changes. Despite being quite subjective this evaluation should provide some rough guides to the utility of a particular system. However,

25X1

TOP SECRET

**TOP SECRET**

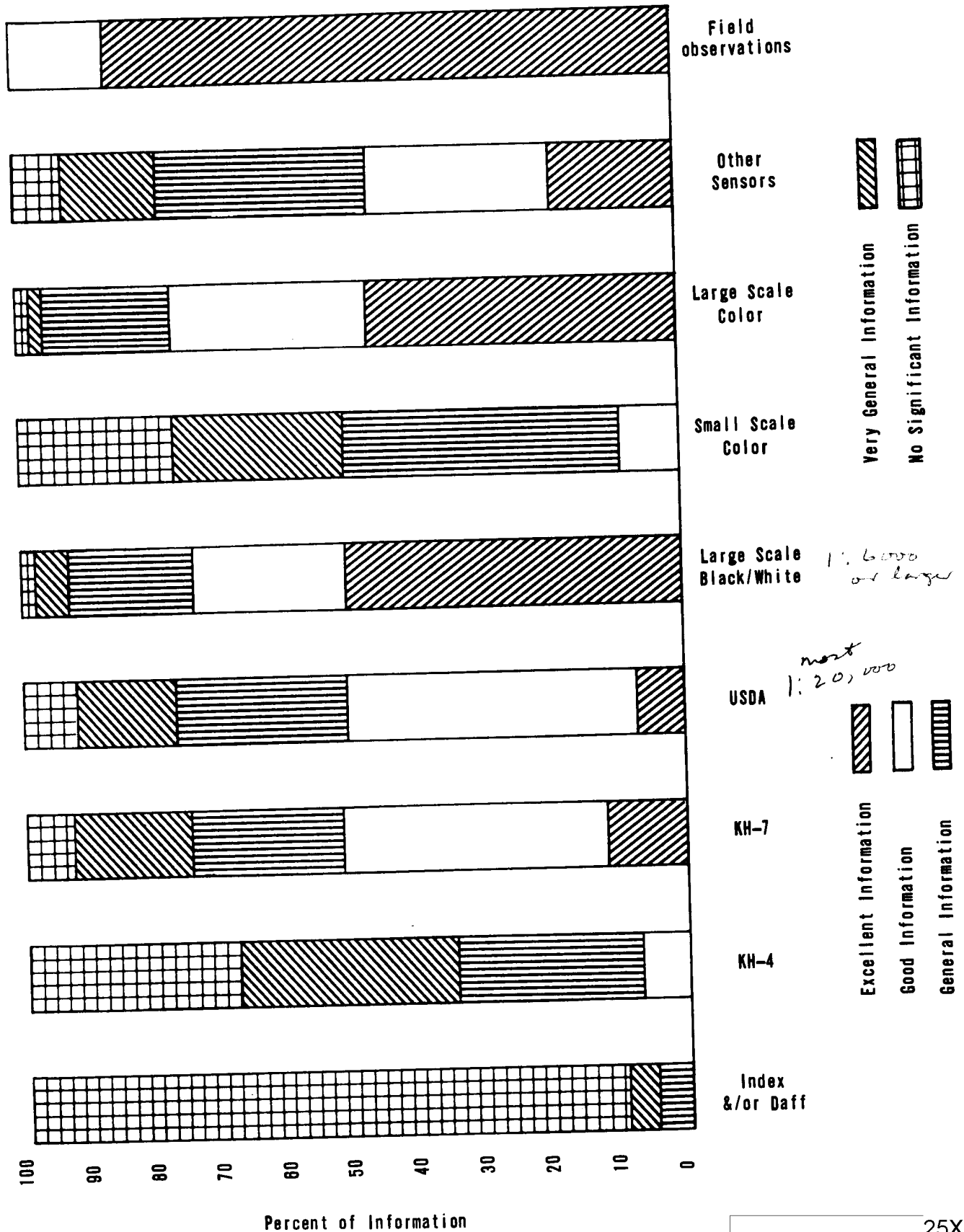
since in general there is a trade-off between area coverage and scale (resolution) the cost of obtaining information with a particular system as compared to field collection must be considered along with the relative efficiency of utilizing various combinations of informational sources which is the normal practice. Since each system is the source for a variety of information with varying reliability, relative cost data for a particular system will be based on a composite of uses and in part quite subjective. The relative cost will be based on a comparison of system costs to ground observation costs.

25X1

**TOP SECRET**

**TOP SECRET**

Figure 1. Forestry Applications - Levels of Information Obtained from Various Systems



**TOP SECRET**

25X1

## TOP SECRET

### Evaluation of Photography for USDA Use

#### Purpose

The purpose of this plan is to evaluate satellite photography for ASCS program use and to suggest some possible uses by other agencies of USDA.

#### Background - ASCS

Primary use of ASCS photography is for accurate delineation of farm boundaries and croplines, for determination of crop acreages. Photography is obtained with an 8.25" f.l. camera at 1:20,000 scale and enlarged for program use to either 1:7920 or 1:3960 scale. Specifications require that photography be obtained when the sky is free from clouds, when the ground is free from snow and standing water and at a sun angle of no less than 30° so that field and croplines are not obscured. Requirements on resolution, distortion, tilt, shutter speeds, filters and various other factors are also specified. It is very helpful if photography can be obtained at a time of maximum contrast between agricultural and physical features to facilitate accurate location of physical features and consequent accurate plotting of crop boundaries.

#### Evaluation Criteria - ASCS

Evaluation will be based upon a comparison of conventional photography at program scale (1:7920) with unrectified enlargements of identical areas from the KH-4, 5 and 7 camera systems made to approximately the same scale where possible.

##### A. Areas selected for comparison

Pheonix, Arizona

Central Valley, California

Seattle, Washington

Virginia

25X1

TOP SECRET



## TOP SECRET

### B. Factors for evaluation and comparison

#### 1. Resolution

- a. Acutance
- b. Emulsion grain size

#### 2. Metric fidelity, if possible

- a. Linear distances parallel to shutter slit
- b. Linear distances perpendicular to shutter slit
- c. Area measurements

#### 3. Specialized equipment required to produce rectified enlargement to 1:7920 scale from KH-4, KH-5 and KH-7.

##### a. Photographic

High resolution enlarger - rectifier

High resolution contact printer

Precision continuous tone film and paper processors -

11" and 30" widths

Quality control equipment

Sensitometer

Densitometer

pHmeter

Various chemical laboratory glassware and equipment

##### b. Photogrammetric:

Comparator type mensuration equipment

High resolution and magnification scanning viewer

High resolution and magnification stereo

Motorized film viewing tables

Computer

25X1

TOP SECRET

**TOP SECRET**

4. Specialized requirements for practical ASCS use of KH-4 and KH-7 photography:
  - a. Area of sufficient size
  - b. Cloud free
5. Unique advantages of KH systems
6. Disadvantages of KH systems

Possible Application in Other USDA Agencies

Other evaluations of the KH photography systems by discipline are being made by other members of ARGO. Some possible applications which may be useful will be suggested based on the following materials:

- A. Prepare mosaic of a state from KH-4 and/or KH-5
- B. Prepare mosaic of a county from KH-4 photography
- C. Prepare mosaic of a major city from KH-4 photography
- D. Possible uses of above mosaics:
  1. Planning base
  2. Urbanization study
  3. Pollution control
  4. Recreation area studies
  5. Drought or rainfall studies

Areas will be selected for A - D above.

Exhibits

1:7920 photography of following area:

<u>Area</u>	<u>Camera System</u>
Phoenix	ASCS
	KH-4
	KH-7
	DAFF or Index (1:500,000 Scale)

25X1

**TOP SECRET**

**TOP SECRET**

<u>Area</u>	<u>Camera System</u>
Central Valley California	ASCS KH-4 KH-7 DAFF or Index
King County Washington	ASCS KH-4 KH-7 DAFF or Index
Willacy County Texas	ASCS KH-4 DAFF

County Mosaic using KH-4 and KH-5

State Mosaic using KH-4 and KH-5

City Mosaic using KH-4 and KH-5

25X1

**TOP SECRET**

## TOP SECRET

### G E O D E S Y

#### (ANALYTIC AEROTRIANGULATION WITH INDEX FRAME PHOTOGRAPHY)

##### Purpose

The purpose of the study is to determine the rms position error of points on the ground as derived by analytic aerotriangulation with index frame photos using the computational system of ESSA Coast and Geodetic Survey.

The study should have significance from at least three standpoints:

(1) insofar as I can determine, such a process has not been investigated and position error values have been obtained only by inference; (2) a numerical value will be derived which can be used in judging and comparing the existing system of photography; and (3) the number can be used as a basis for extrapolating corresponding values which might be obtained by making certain specific improvements in the system.

##### Actions Required of ARG0

1. Glass diapositive contact prints of thirteen (13) overlapping photographs have been requested for a area in California.
2. Coordinate measurement is considered to be accomplished by Raytheon/Autometric with their personnel and on their existing equipment.
3. Computation will be done by ESSA Institute of Earth Science on the ESSA CDC 6600 in Suitland, Maryland, using ESSA-C&GS programs (which the investigator has helped develop).

##### Security Consideration

The only materials that will be necessary to remove from the secure area are IBM punch cards that do not disclose what the numbers represent nor where they came from.

TOP SECRET

25X1

**TOP SECRET**

The computer output does not reveal the kind, source, or identification of the photography from which the measurements are made.

Method

The same general method is proposed as that of [ ] recently applied to two (2) photographs [ ]

25X1

25X1

1. Control will consist of recognizable features scaled from 1/24,000 USGS quads.
2. Image coordinates will be measured on the Gilleland (or Mann) comparator.
3. A PUG stereoscopic point transfer device may or may not be used, depending on operational circumstances.
4. An attempt will be made to select as pass points exclusively those that can be map identified.
5. Film distortion corrections will be applied by using the reseau on the photos.
6. Lens distortion for the relevant Biotar lens will be applied as part of the computation.

Control data can be expressed either in latitude and longitude (geographic coordinates) or in State plane coordinates. The former are expected to be preferable; in either instance they will be transformed by a C&GS program into a local secant plane (geocentric) rectangular cartesian system in which the evaluation will be made.

**TOP SECRET**

25X1

**TOP SECRET**

The C&GS program allows the necessary geometric restraints. No difficulty is encountered by the fact that one flight virtually is over the top of another one. The collinearity condition is applied exclusively. A simultaneous adjustment of all the image rays from all the photographs, along with all the control, is provided in a least-squares fashion which minimizes the discrepancies of coordinate measurement.

**TOP SECRET**

25X1

## TOP SECRET

### G E O L O G Y

#### (Evaluation for Geologic Applicatons)

The Phase III evaluation for geologic applications will have three main parts:

- (1) An objective, semiquantitative comparison of very high altitude photography and conventional aerial photography in selected areas of the USA where the geology is fairly well exposed and has been mapped in detail.
- (2) An overall comparison of the general levels of geologic information obtainable from various systems.
- (3) A brief description of certain types of investigation in which the special attributes of very high altitude photography would be useful.

#### Comparison of Very High Altitude and Conventional Photography

Aerial photographs have been used intensively as an aid to geologic investigations for more than 25 years. The general principles of interpretation, the environmental factors affecting their use, and the kinds of information that can and cannot be obtained from them are well known and given in text books. The usefulness of very high altitude photography, therefore, depends very largely on the advantages and disadvantages it may have compared with conventional photography. The first part of the evaluation, therefore, is designed to compare, by sampling, the amount of information that can be extracted from the two types of photography using a uniform method of study.

The comparison will be made for selected areas where (1) surface investigations have provided geologic maps and reports giving far more information

25X1

TOP SECRET

**TOP SECRET**

than could possibly be obtained from the photographs alone, so that the amount of information extracted from both types of photography can be expressed as percentages of this larger body of information, and (2) geologic features are relatively simple and well exposed, so that these percentage figures will be relatively high and thereby significant. The main basis of comparison will be the linear miles of geologic boundary that can be discerned on the two kinds of photographs as compared with the linear miles shown on the existing geologic maps.

Geologic boundaries are the single most useful kind of geologic information commonly provided by photographs, are more or less representative of the general information value of photographs, and provide a more objective basis for quantitative measurement than most other attributes.

An examination will also be made for things that appear on the very high altitude photographs that do not appear on other photos or maps.

Three or four areas will be selected from the following regions after preliminary examination of KH-4 photography and determination of the availability of good conventional photography:

California Coast Range

Owens Lake - Mono Lake Region, California

Nevada Test Site

Valles Mountains Caldera, New Mexico

Denver, Colorado

Northern Great Plains (glacial features)

Comparison of General Levels of Geologic Information Obtainable from

Various Systems

Very high altitude photographs, like most other systems and tools, can provide only part of the total geologic information needed for various representative applications, such as engineering, mineral exploration, oil and gas investigations,

25X1

**TOP SECRET**



**TOP SECRET**

hydrology, soil studies, etc. Comparison of various systems for gathering data will involve listing all the categories of geologic information commonly needed for a wide variety of applications, and rating each system for its potential contribution to each category. These ratings will necessarily contain many subjective elements, but the summation should express, fairly reliably, the relative usefulness of any system in providing a wide variety of geologic information for a large and diverse area. Experience in Phases I and II of the project, as well as Phase III, will provide background for the evaluation.

#### Special Investigations

Very high altitude photography may ultimately prove to be uniquely useful in certain kinds of topical investigations, where it is desirable to scan enormous areas very quickly looking for one thing on essentially a yes-no basis. Topics of this nature that might justify considerable effort include reconnaissance for recent fault scars and evidences of landslides. A search for meteorite scars would represent more academic uses of the same general type.

**TOP SECRET**

25X1

**TOP SECRET**

H Y D R O L O G Y

During Phase III the Project ARGO hydrologists plan to evaluate the usefulness of KH-4, KH-5 and KH-7 photography to civil activities in the field of hydrology. The attached outline indicates the proposed scope of the evaluation.

Project hydrologists intend to evaluate the contribution that each photographic system can make in: (1) education, (2) broad hydrologic planning and management, (3) detailed water resources development and conservation, and collection of water resources basic data. KH imagery will be compared with published reports and maps and with conventional aircraft photography to: (1) determine what types of hydrologic questions may or may not be answered with the use of KH material, and (2) ascertain the validity of the findings from KH photography by comparing the results with as much ground truth as possible. Exhibits consisting largely of photographs and map overlays will be used to illustrate findings. Watersheds in the vicinity of La Paz, Bolivia and Washington, D.C. will be studied as part of the evaluation.

Project hydrologists intend to prepare a brief summary report of the Phase III findings along with accompanying exhibits.

25X1

**TOP SECRET**

**TOP SECRET**

- I. EDUCATION
- II. BROAD WATER RESOURCE PLANNING AND MANAGEMENT
  - A. World and Continental
  - B. National
  - C. River Systems
  - D. Ground Water Systems
- III. DETAILED WATER RESOURCE DEVELOPMENT AND CONSERVATION
  - A. River Basins
  - B. Watersheds
  - C. Ground Water Areas
  - D. Constructions Site Plans
- IV. BASIC DATA
  - A. Surficial Geology
  - B. Soils
  - C. Land Use
  - D. Precipitation
  - E. Snow
  - F. Glaciers
  - G. Evaporation
  - H. Transpiration
  - I. Surface Water
  - J. Ground Water
  - K. Water Quality
  - L. Damage Evaluation

**TOP SECRET**

25X1

## TOP SECRET

### E N G I N E E R I N G

#### (Cultural Features)

Phase III will provide for continued evaluation of possible engineering uses of satellite photography by:

- A. Making additional photointerpretation of man-made (Cultural) features on KH-4 and KH-7 system photography. "Engineering" Phase III studies will be concentrated in the La Paz, Bolivia area as was the work for Phase II. To assist in the Phase III study, enlargements of 10X, 20X, and 40X of engineering structures (dam, power houses, and water treatment plant) have been requested. Standard aerial photos of portions of La Paz have been ordered to permit a comparative analysis with the satellite photography.
- B. Reviewing present day uses of standard aerial photography in power and highway planning and development.

It is recognized that all disciplines covered by studies made within Project ARGO are interrelated with "Engineering" inasmuch as specialized engineering is required to implement development, exploitation and oftentimes exploration within the particular fields. To this end, the findings of the project team members should be considered as interdependent with any "Engineering" conclusions.

25X1

TOP SECRET

**TOP SECRET**

M A R I N E   S C I E N C E S

Purpose

The purpose is to investigate the use of satellite imagery in the study of the marine sciences.

Hydrography

A study will be made of the use of satellite imagery as an aid in the production of nautical charts and bathymetric maps. In this regard it will be necessary to determine the resolution capability of the satellite systems (using KH-4 and KH-7 systems) and the limitations imposed by the geometric properties of the imagery. Comparisons of satellite imagery with published nautical charts and bathymetric maps will be made. Comparison of satellite photographs with existing aerial photographs will be made to determine the relative merits of each as applied to the production of nautical charts.

Areas chosen for special study include:

1. Rio De La Plate Estuary
2. Colorado River Estuary
3. Washington Coast
4. Tierra del Fuego

Oceanography

The use of satellite imagery in the marine sciences will be investigated. Emphasis will be placed on the determination of those phenomenon that may be most effectively observed. These include such sea surface features as waves, water mass boundaries, currents, estuarine mechanics, water pollution, and ecology of marine organisms.

**TOP SECRET**

**TOP SECRET**

Areas of special interest include:

1. The Rio De La Plate Estuary
2. Colorado River Estuary
3. Washington Coast
4. An atoll in the Caribbean Sea

Time series studies will be made. These will require the use of several passes over some study areas.

Comparisons with ground truth in the areas of interest will be made when such data are available.

**TOP SECRET**